



Disaster Risk Reduction for Natural Hazards: *Putting Research into Practice*

ABSTRACTS



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Disaster Risk Reduction for Natural Hazards: *Putting Research into Practice*

November 4th-6th 2009 at University College London

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DAY 1: WEDNESDAY 4TH NOVEMBER

SESSION 1: WHAT IS DISASTER RISK REDUCTION AND HOW DOES IT WORK IN PRACTICE?

Chair: Stephen Edwards, Aon Benfield UCL Hazard Research Centre, University College London

ORAL PRESENTATIONS

SPECULATION NOT EXTRAPOLATION: PREPARING FOR HAZARDS IN A FUTURES CONTEXT

Kent, R.

Humanitarian Futures Programme, King's College London

Contact Email: randolph.kent@kcl.ac.uk

Trends analysis and extrapolation have underpinned much of the work on future risks and hazards. In this presentation, it will be argued that more time has to be given to "the art of speculation" as a way to deal with those abiding uncertainties and complexity that are hallmarks of the future. In this context possible inter-relationships have to be anticipated between new types of crisis drivers and traditional hazards, and there is no direct evidenced-base research that will give us guidance.

What does this suggest about the utility of hazard research in a futures context?



MAKING HOLES IN THE FENCE? REFLECTIONS ON INTERDISCIPLINARITY AND COLLABORATION IN DISASTER RISK REDUCTION RESEARCH

Barclay, J. and Simmons, P.

School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ

Contact email: j.barclay@uea.ac.uk

Despite advances in physical and social characterisation of natural hazards, losses from natural disasters continue to increase rapidly. This implies the need for a fresh approach and attention is increasingly focused on developing and championing interdisciplinary and collaborative approaches to hazard and disaster research. Despite the insights offered by a growing but rather fragmented body of relevant literature, there is as yet little in the way of a blueprint for successful collaborative research and developments remain patchy across differing natural hazard fields. Researchers engaged in such efforts face significant challenges as they attempt to negotiate the institutional and cultural boundaries between scientific disciplines and between science and the wider society, including policy actors, interest groups and affected communities. Dealing with these challenges takes time and not all physical scientists perceive there to be a strong need for or clear benefits from closer integration with other disciplines. Consequently, research efforts very often proceed in disciplinary isolation, while the integration of 'non-scientists' into a research program can be relegated to an end process seen as 'risk communication'.

Researchers from physical and social sciences concerned with the role of science in disaster risk reduction came together in two UK NERC-ESRC sponsored processes: the SPIDER network and a recent international workshop. They identified a need to:

- build collaborative relationships from the inception of research programmes, beginning with the development of a shared language, or at least a reciprocal understanding of each others' languages;
- develop a closely integrated approach in order to reduce risk, particularly where outcomes of uncertain behaviour are poorly understood;
- focus on creating knowledge most likely to increase community resilience to multiple natural hazards, involving an active, even co-productive, role for affected communities in the knowledge production process.

These and other conclusions will be elaborated and their implications considered.



DISASTER RISK REDUCTION IN PAKISTAN: EARTHQUAKE RESISTANT HOUSING

Harris, V.

Article 25, London

Contact Email: victoria-harris@article-25.org

In a natural disaster it is often not the disaster itself that kills people, but buildings collapsing or transforming into dangerous projectiles. Article 25 is a technical NGO providing construction design expertise to build back better after disaster and reduce vulnerability to future disaster by designing more resilient buildings. High value design skills and academic ingenuity are implemented through local materials and technology to bring life-saving solutions to some of the most disaster struck areas of the planet.

After Pakistan's devastating earthquake of October 8th 2005, Article 25 and Muslim Aid mobilised their earthquake reconstruction programme to deploy seismic resistant design within a wider strategy of community development. The technology used may surprise some: high-tech seismic resistant designs have little traction in a country where millions live in poverty and solutions have to be delivered on a mountainside where resources and skills are scarce. We adapted the vernacular technologies of the region to create simple housing solutions to be delivered on the widest scale. The technical 'hardware' Article 25 provided was implemented in partnership with Muslim Aid's community 'software' programme to create long term resilience and improved capacity for the most vulnerable members of the community.

Background

Article 25 is a UK based NGO working across Africa, Asia and Eastern Europe providing built solutions to global problems. We are named after the 25th Article of the Universal Declaration of Human Rights which supports the belief that adequate, dignified buildings and housing are fundamental to our human rights. It also enshrines other basic rights which require a built contribution to their fulfilment. Article 25 aims to cement and elevate the critical role that the built environment plays in the fulfilment of human rights and millennium development goals.



UNDERSTANDING COMMUNITY RESILIENCE

DFID Disaster Risk Reduction Interagency Coordination Group

Desai, B. (Christian Aid); Ruiz, C. (Christian Aid); Hall, N. (Plan International); Chadburn, O. (Tearfund); van den Ende, P. (Practical Action); Roots, R. (British Red Cross) and MacDonnell, Y. (Action Aid)

Contact Email: bdesai@christian-aid.org and oenone.chadburn@tearfund.org

The 'Characteristics of a Disaster-resilient Community' guidance note^[1] outlines a set of components and characteristics that show what a community (village, district, local area etc.) would look like if all elements of disaster risk reduction (DRR) were applied successfully. As the Characteristics have been mapped out under Thematic Areas related to the priority areas of action of the Hyogo Framework, they have become directly relevant to current international debates on understanding progress in DRR and building resilience. The initiative was developed by a group of agencies^[2] active in disaster risk reduction with John Twigg of the Benfield Hazard Research Centre at University College London, and over the last two years the Characteristics have been field-tested by a number of organisations across the world.

The commissioning agencies have used the Characteristics of a Disaster-resilient Community in a variety of ways. This presentation will unpack the concepts of vulnerability and resilience by showcasing how an innovative framework such as the Characteristics can be used to develop baselines, plan for, implement and review disaster risk reduction at the local level. Moreover, examples will be given how they have been used in capacity building and academic teaching, for field research and data analysis, and for effective policy and advocacy. Experience from these agencies shows that innovative and tailored use of the Characteristics helps practitioners, researchers and community members to:

- understand the full scope of resilience, DRR and the Hyogo Framework for Action;
- identify gaps and needs for technical expertise more clearly;
- see the value of partnerships and networking; and
- appreciate the role that the 'enabling environment' plays in building resilience.

^[1] Twigg, J. (2007). Characteristics of a disaster-resilient Community. A Guidance Note. For the DFID Disaster Risk Reduction Interagency Coordination Group.

^[2] Action Aid, British Red Cross, Christian Aid, Plan International, Practical Action and Tearfund.



MAPACTION: DISASTER RESPONSE AND PREPAREDNESS

Woof, N.

MapAction

Contact Email: nwoof@mapaction.org

MapAction is a disaster response charity. The talk will describe how MapAction deploys teams of professionally-trained volunteers to map humanitarian disasters as a crisis unfolds. Since a first emergency deployment in the immediate aftermath of the Asian tsunami in December 2004 MapAction has carried out over twenty disaster missions in Asia, Africa, South America and the Caribbean, involving earthquake, hurricanes, volcano, and floods. Technical preparedness and extensive training in a wide gamut of relevant skills is necessary to ensure a collection of individuals is able to operate as an effective team in an emergency. An understanding of the context of a humanitarian situation is very much part of this preparation. Teams have to respond to information requests from a varied range of relief organisations and an understanding of the diverse mapping requirements is essential.

MapAction also conducts a programme of short, capacity building projects in developing countries, and trains professional emergency workers worldwide. Broadly, the charity has carried out nearly twenty capacity building missions, and trained over 1500 professionals on more than forty international courses. The talk will outline examples of these activities and show that their primary aim is to impart training in disaster preparedness. The core part of this activity is training in GPS and data collection skills, and in teaching the rudiments of mapping software. As part of this disaster preparedness thrust, and to promote interoperability with other relief agencies MapAction also sends teams to participate in international disaster-simulation exercises; locations include China, Mongolia, Philippines, Armenia and Sweden. Most recently MapAction has teamed up with the UK Royal Institution of Chartered Surveyors, through their BuildAction initiative, to participate in a joint disaster risk reduction project in Kenya.



'TAKING STOCK' - CHALLENGES IN CONNECTING DISASTER RISK REDUCTION POLICY AND PRACTICE

Oxley, M.

Global Network of Civil Society Organisations for Disaster Reduction

Contact Email: marcus.oxley@tearfund.org

With a wry but wise smile, Donald Mtetemela, a development worker for over 25 years and head of an East African development organisation, looked to the sky and explained:

"The people I work with every day see many clouds – international initiatives and plans, but very little rain - actual change at the frontline."

It's an image that sums up the challenge of turning the Hyogo Framework for Action (HFA) 2005-2015 – a global blue print for preventing disasters - into practical, sustainable activity. "Clouds but little rain" was the name given to the Views from the Frontline (VFL) action-learning initiative which brought together 7,000 people and 400 organisations in 48 countries in a unique collaborative action designed to paint a global picture of the progress being made in implementing disaster reduction activities where it matters most – at the frontline where vulnerable people live and work.

The VFL review provided substantive evidence (supported by findings from the UNISDR Global Assessment Report) that despite progress at international and national policy levels the greatest barrier to achieving a substantial reduction in disaster losses by 2015 is the lack of a systematic implementation of disaster risk reduction activities at the grassroots level. Reports of progress fade as activities get closer to vulnerable people, particularly high risk groups such as women and children.

Similar challenges will be faced in turning internationally and nationally-formulated climate adaptation policies into tangible action at the grassroots level commensurate with the rapid growth in climate vulnerability. Like DRR and its close relation poverty alleviation, the impact of climate change adaptation must be on the ground where people at-risk live, eat and work. Like DRR and poverty alleviation, the objective at the local household level comes down to the same thing – the security and wellbeing of people's life's, livelihoods and assets.

Without careful consideration at what point climate adaptation, risk reduction and poverty alleviation intersect there will be considerable risk of duplication of efforts. Significant resources will be consumed within inefficient bureaucratic channels rather than delivering resources down to local actors. Crucially, experience and insights gained through the realities of DRR execution at the local level provides relevant learning and policy recommendations that are transferable to global efforts to build adaptive capacities. The presentation serves to highlight some of these key findings and recommendations aimed at accelerating progress to building resilience at the local level through a comprehensive approach to vulnerability reduction



DAY 2: THURSDAY 5TH NOVEMBER

SESSION 2: QUANTIFYING HAZARDOUS NATURAL PROCESSES

Chair: Christopher Kilburn, Aon Benfield UCL Hazard Research Centre, University College London

ORAL PRESENTATIONS

PROBABILISTIC CATASTROPHE MODELS FOR DISASTER RISK REDUCTION

Muir-Wood, R.

Risk Management Solutions

Contact Email: Robert.Muir-Wood@rms.com

Probabilistic catastrophe risk models, developed first for the insurance industry, provide appropriate tools for designing and testing alternative disaster risk reduction strategies. As there will always be a wide range of potential catastrophes it is important to consider a full stochastic set of potential events and their appropriate probabilities, rather than to focus on a small number of specific scenarios. Catastrophe models link hazards to their losses through the use of exposure data and vulnerability functions. Exposure can be expressed as housing units, populations, or values at risk. The output of the model is delivered in the form of exceedance probability (EP) relationships and their integrals - the average annualized losses (AALs). Based on these metrics the benefit v costs of alternative disaster management strategies can be tested through their impact on loss EPs and AALs. In the future, Government Chief Risk Officers will use probabilistic catastrophe models for planning disaster reduction strategies or auditing alternative climate change adaptation measures.



WHAT CAN WE SAY ABOUT THE NEXT SUMATRAN TSUNAMI?

McCloskey, J. (1); Bhloscaidh, M.N.; Natawidjaja, D.; Nalbant, S.; Bell, A.; Main, I.; Naylor, M. and Greenhough, J.

(1) University of Ulster

Contact Email: j.mccloskey@ulster.ac.uk

It is widely believed that the Sunda subduction zone west of Sumatra will rupture again soon in another event with enormous destructive potential. The likely location and approximate size of the event has been estimated but what damage will it do? To answer this we must constrain the likely spatial distribution of slip which is known to control tsunamigenesis. Uniquely, it might be possible to address this question for the threatened event.

The Sumatran coast and offshore islands are colonised with coral microatolls whose growth habit records the vertical component of deformation extending back up to 700 years. We have developed a new method for inverting these data for the slip on past earthquakes. Rather than asking: what was the slip distribution on an historical earthquake? We instead ask: what are the set of slip distributions which could have produced the observed vertical coral displacements? We generate many ($\sim 10^8$) stochastic slip models and compute the coral displacements for each, storing those which satisfy some goodness-of-fit criterion. Stacking the successful models yields a map of the probability of slip; it is probable that areas of high slip in the map experienced high slip in the earthquake.

The method is applied to the 1797 (M8.7) and 1833 (M9.0) Sumatran earthquakes. We show that the most likely distribution of slip on these events correlates well with areas of strong coupling exposed by inversion of recent geodetic data indicating that the spatial distribution of coupling has persisted for more than one seismic cycle. Estimates of Coulomb stress interaction based on the most likely distributions of slip show that the 1833 event was encouraged by 1797 quake but that knowledge of the distribution of coupling, plate convergence rate and interaction stress could not have produced an accurate, deterministic forecast of the slip on either event. This suggests that Monte Carlo simulations of rupture and tsunami generation which have been constrained by the measured distributions of plate coupling and convergence, possibly augmented by stress interaction studies, will provide the best, probabilistic estimates of the impact of future earthquakes in this region.



FORECASTING EARTHQUAKES: THE STATE OF THE ART

Bell, A. and Main, I.G.

School of GeoSciences, University of Edinburgh

Contact Email: a.bell@ed.ac.uk

The ability to predict the location, time, and magnitude of an earthquake is the “holy grail” of seismology. In reality, the highly complex and non-linear dynamics of the earthquake process means that deterministic short-term prediction within narrow limits is not feasible. Consequently, progress in earthquake prediction must involve fully probabilistic forecasts where model and data uncertainty is accounted for and quantified. Recent initiatives have marked the start of an extensive international effort to develop three key components necessary for reliable earthquake forecasting: (1) extensive and consistent datasets; (2) effective forecasting models that include quantitative uncertainty analysis and (3) an independent, prospective testing procedure to evaluate model performance against an appropriate null hypothesis. Improvement in data quality requires the integration of regional monitoring arrays, establishment of reliable historical catalogues and the development and adoption of standard data formats and transfer protocols. These are goals of the ongoing EC FP6 project, Network of Research Infrastructures in European Seismology (NERIES). Time-dependent forecasting models fall into two broad categories. Physical models determine changes in earthquake probability due to quantifiable physical perturbations caused by the history of earthquakes, such as Coulomb stress changes. Statistical models apply empirical laws, such as Omori’s Law and the Gutenberg-Richter distribution, to predict future behavior. Time-dependent models have been applied retrospectively to single mainshock-aftershock sequences, and are beginning to be run prospectively in Italy and Southern California. These models must be shown to provide an above-chance probability gain, which requires prospective testing. The best approach to testing is still debated, but a lead has been taken by the Collaboratory for the Study of Earthquake Predictability (CSEP), an international collaboration of statistical seismology laboratories. CSEP has developed and applied a uniform and objective test protocol for evaluating forecasting power, and has established regional centres in California, Europe, Japan and New Zealand.



QUANTIFYING HAZARDS AND RISKS WITH EXPERT JUDGMENT

Aspinall, W.

University of Bristol

Contact Email: willy.aspinall@bris.ac.uk

Expert judgment is used extensively (and often unwittingly) in almost every aspect of the modelling, assessment and management of natural hazards and risks. Traditionally, approaches for working up and providing scientific inputs to decisions have tended to be informal and often decided, ultimately, by a single scientist. The advantages of polling a breadth of scientific views are neglected and, frequently, the scientific advice process poorly documented, leaving it open to lay and - more ominously – to legal criticism. When data are sparse or ambiguous, or the situation urgent, various structured elicitation approaches are possible and alternative ways are available for pooling a range of expert judgments to determine quantitative parameters and probabilities in the presence of scientific uncertainty. In seeking an optimal solution to the challenge of weighting different experts, one formalism, due to Cooke (1991), has the important attribute of empirical control in its expert scoring scheme. This procedure was used by the Montserrat Volcano Observatory in the early months of the volcanic crisis, and subsequently by the Montserrat Scientific Advisory Committee at its regular meetings. The extensive expert judgment data thus generated provide insights about its application under crisis conditions and, latterly, to assess the positive probabilistic forecast skill of the SAC group in repeated prognoses of future activity. Risk assessment elicitation for these and other scientific, technical and medical issues, produce one important finding: the formalized quantification of collective scientific judgment usually results in wider uncertainty bounds than would be expressed individually by the majority of scientists. This outcome can be unwelcome to problem owners and decision makers – who seek definitive yes/no responses - and even to some scientists. A structured elicitation approach does not, however, supplant serious scientific thought and discussion, but acts as an aid for focusing and clarifying those processes. Most experts, when they adjust to the distinctive concepts and principles of weighted elicitation, are happy to embrace the procedure for practical, professional and other advantages; these will be summarized.



ASSESSING VOLCANO FLANK INSTABILITY: MORNE AUX DIABLES, DOMINICA

Teeuw, R. (1); Argyriou, N. (1); Biejat, S. (1); Dilmot, N. (1); Rust, D. (1) and De Roche, T. (2)

(1) Geohazard Research Centre, University of Portsmouth

(2) Office of Disaster Management, Commonwealth of Dominica

Contact Email: richard.teeuw@port.ac.uk

Potentially tsunamigenic volcano flank instability features have been observed on the north coast of Dominica. Seismic, bathymetric and geomorphological data suggest that this coast is bounded by an active fault structure, with the relatively up-thrown flank displaying evidence of slope instability. Studies during 2007-8 indicated a landslide block of ~1 M tonnes on the seaward margin of the flank instability complex, the collapse of which could generate locally-significant tsunami waves around Dominica and the adjacent Guadeloupe archipelago.

Current research aims to quantify the landslide and associated tsunami hazards. The first stage is examining the nature of the volcano flank instability and preliminary results from recent fieldwork are presented here. The second stage will focus on the tsunami hazard, examining coastal bathymetry along the north flank of Morne aux Diables and looking for evidence of past landslides.

Fieldwork during July-August 2009 used Google Earth and 1:10,000-scale aerial photography as the basis for geomorphological mapping and the selection of survey transects. Most of the transects radiated out from Morne aux Diables crater (600-660 m asl), northwards to coastal cliffs that were up to 300 m high; most followed ridges, as these consist of in situ rock, whereas Dominica's valleys have fills of alluvium and slope debris.

The transects were sampled by a geomorphological survey (slope steepness, slope morphometry, soil type, soil thickness, rock type, vegetation cover) and a VLF geophysical survey. Preliminary results indicate many E-W trending zones of structural weakness in the northern flank of the volcanic edifice, with faults extending for hundreds of meters, some forming water-filled voids. Areas of hydrothermal alteration appear to favour landsliding, with large (>100 m high) sub-vertical slab failures dominating in the E-W fault zone and large rotational slides occurring on the NE and NW coasts.



TSUNAMI HAZARD MAPPING AND RISK ASSESSMENT FOR THE CITY OF PADANG / WEST SUMATRA

Schlurmann, T. and Goseberg, N.

Franzius-Institute for Hydraulics, Waterways and Coastal Engineering, Leibniz University Hannover, Nienburger Str. 4, 30167 Hannover, Germany

Contact Email: schlurmann@fi.uni.hannover.de

The location of the city of Padang on the western coast of West Sumatra in the direct neighborhood to an active seismic zone in the Indian Ocean leads to an extreme risk of adjacent local communities exposed to potentially destructive tsunamis. An effective tsunami hazard mapping and risk assessment of such extraordinary natural disasters aiming at improved evacuation and coping strategies as well as upgrades in disaster management on the very local scale is based to a first order degree by the quality of the underlying datasets and its subsequent scenario modeling techniques.

Within the framework of the project "Last-mile Evacuation" funded by the German Ministry for Education and Research (BMBF) several scientific groups have started in an multidisciplinary approach to meet the necessary requirements for the city authorities of Padang and local disaster preparedness groups to expand and disseminate crucial knowledge about credible tsunami inundation dynamics, risk and vulnerability assessments and optimized evacuation procedures based on highly resolved geo-databases and socio-economic datasets surveyed and acquired.

This paper highlights the scientific methodology and multidisciplinary character of data usage and the interaction of groups within the project, and, moreover focuses on the highly-resolved tsunami inundation dynamics conducted for further preparedness practices and intended for better communication with local stakeholders as the elementary component for disaster mitigation in Padang.



POSTER PRESENTATIONS

WHERE THE WALLS COME TUMBLING DOWN: PREDICTING EARTHQUAKE HAZARD IN VANUATU

Cartwright-Taylor, A.

Department of Earth Sciences, University College London, Gower Street, London WC1E 6BT

Contact Email: alexis.ct@gmail.com

This study has generated a historical earthquake disaster database for Vanuatu by determining which events in the historical earthquake event catalogue caused moderate or greater damage within the governing area councils. It is anticipated that this new database will facilitate the identification of earthquake hazard hotspots in order to help prioritise disaster management initiatives in Vanuatu and reduce the risk of disasters in the future. In the process of doing so, it established the parameters by which to define moderate damage, and developed and validated a predictive ground motion model to show the spatial distribution of ground motion intensity for each event. A predictive model was necessary due to the limited amount of earthquake effects data in Vanuatu.

The resulting outcomes of the study are as follows:

- A validated ground motion estimation model for Vanuatu based on the ground motion prediction equations of Youngs *et. al.*, (1997).
- A national earthquake disaster database cataloguing the degree to which area councils have been affected by historical earthquakes and associated ground motion intensity maps for each event within the database.

These outcomes are presented here, together with the parameters defining moderate damage and the methods used to develop and validate the model and populate database. A geographic information system tool was used to apply the model to the earthquake catalogue and populate the database, which proved to be invaluable in meeting the objectives of the study.

The subsequent evaluation of these outcomes reveals a number of limitations inherent to the database, such as those associated with the earthquake event catalogue, those intrinsic to the ground motion prediction equation itself and the assumptions necessary in the application of the equation to Vanuatu. However, the study concludes that the benefits of the database in the disaster management context outweigh its limitations. In addition, actions that could be taken to improve the ground motion prediction model developed during the study are addressed and wider applications of the model are identified.



TRANSLATING SCIENCE: RISK, UNCERTAINTY AND POLICY ADVICE

Donovan, A. (1)(2); Oppenheimer, C. (1) and Bravo, M. (2)

(1) Department of Geography, University of Cambridge, Downing Place, Cambridge CB2 3EN

(2) Scott Polar Research Institute, University of Cambridge, Lensfield Road, Cambridge CB2 1ER

Contact Email: ard31@cam.ac.uk

“Policy” is an elusive term, associated with official decisions and their implementation, based on some kind of authority. Etymologically, it relates to the polis – the city – again with connotations of security and more particularly of organisation and institution, order imposed on nature, even in spite of nature. Volcanologists who have been involved in giving scientific advice to governments in volcanic crises are familiar with the problems that occur in policymaking given high levels of uncertainty, not least the dilemma of authority: uncertainty challenges and subverts expertise even as it is applied, yet the management of that expertise and its application to policy is fundamental for public safety.

Volcanologists have suggested a number of ways to generate quantitative information for policymakers in times of high uncertainty. Bayesian event trees have been employed in Italy, and in Montserrat, and they have many proponents. Similarly, the expert elicitation procedure, adopted by the Scientific Advisory Committee (SAC) on Montserrat, has been used for several years to advise government officials seeking to manage populations, land and coastlines. Such representations of uncertainty cut directly across the social and physical sciences, blurring boundaries - such as that between objective and subjective - and creating new areas of research (eg Barclay 2008). A key debate concerns the relative merits and pitfalls of particular monitoring techniques and the ways in which they and their practitioners can, or cannot, be thrust together, both in statistical models and in crisis conference. Research at the Montserrat Volcano Observatory will be used to reflect on this question and the social implications of the expert elicitation procedure used by the SAC. Some preliminary conclusions concerning the progression of this ongoing discourse in volcanology will be drawn in the light of the Sociology of Scientific Knowledge and its implications for risk mitigation on active volcanoes.



REMOTE SENSING FOR DISASTER RISK REDUCTION IN SEMI-ARID REGIONS

Saunders, C. (1)(2) and Teeuw, R. (2)

(1) JARIC; The National Imagery Exploitation Centre, RAF Brampton, Huntingdon, PE28 4YG

(2) Geohazards Research Centre, School of Earth & Environmental Sciences, University of Portsmouth, Burnaby Building, Portsmouth, PO1 3QL

Contact Email: charlotte.saunders@port.ac.uk

With the threat of climate change set to increase the frequency of higher intensity events, it is becoming more important to map areas which may be at risk from natural hazards for disaster risk reduction (DRR). High resolution remote sensing (RS) data may produce the best results; however they are very expensive and not easily accessible for developing countries.

Over recent years, much research has been carried out with regard to mapping hazards using various RS data. There has however, been little advancement in mapping vulnerability from moderate resolution sensors.

It is therefore the aim of this research to develop methodologies for extracting more accurate vulnerability assessments from free or low cost RS data by adapting methodologies developed from expensive higher resolution data. The resulting risk maps can then feed into DRR plans.

The first step in this research is to define vulnerability and assess what information may be obtained from RS. Starting with high resolution data, advanced RS techniques and geospatial analysis will be used to develop methodologies to extract this information with field work being carried out to test the accuracy of these models. Attempts to extrapolate these models to moderate resolution sensors will then be tested.

Additionally, past research has focused on the use of, what can now be considered, aging satellites and data. The accuracy of these datasets needs to be addressed, especially with regard to the dynamic nature of vulnerability mapping.

A first attempt to map hazard and vulnerability has been carried out in a mountainous, coastal region in SE Spain as a test area. Initial results are promising, but require further analysis at this stage.



ADVANCES IN PHYSICAL MODELLING OF NEARSHORE TSUNAMI WAVES AND THEIR IMPACT USING A UNIQUE TSUNAMI GENERATOR

Charvet, I. (1); Lloyd, T. (1); Rossetto, T. (1); Allsop, W. (2); Robinson, D. (2); Bazin, P.H. (3) and Robinson, T. (1)

(1) Department of Civil, Environmental and Geomatic Engineering; University College London, Gower street, London WC1E 6BT

(2) HRWallingford, Howbery Park, Wallingford, OX10 8BA

(3) Ecole Centrale de Lyon, 51, Chemin des Mouilles 69130 Ecully, France

Contact Email: i.charvet@ucl.ac.uk

Tsunami waves travel across oceans with quite small vertical displacements but shoal up dramatically in nearshore depths, causing extensive loss of life and infrastructure. The generation and transformation of tsunami waves from source to nearshore can be simulated by various numerical models. However, knowledge on the propagation of the tsunami wave in the nearshore region, across the shoreline, and then inland is not well modelled by current analysis techniques. These flow processes cannot be simplified easily, and are made significantly more complex by interactions with beaches, sediment, coastal defences, and then around buildings. Physical modelling could be used to study the flow and force processes, but correct generation of the tsunami wave(s) is essential and conventional wave generators simply do not have the piston stroke to reproduce neither the required wavelength (which would often approach the total length of the test facility), nor the receding wave at the coast. The Earthquake and People Interaction Centre (EPICENTRE) research initiative has initiated a collaboration between UCL (University College London) and HR Wallingford (HRW) to solve the obstacles to physical modelling of tsunamis and their impact. Within this project, HRW has constructed an innovative Tsunami Generator which uses the principles of HRW's pneumatic tide generators to generate realistic tsunami waves (viz. The "Mercator" record from the Boxing Day Tsunami). The Tsunami Generator is mounted within a 45m wave flume equipped to measure coastal processes, inundation and wave forces. This paper presents a summary of the working principles of the Generator and describes tests carried out to validate the generated tsunami with previous experiments and observations made following real tsunami events. The first results of tests carried out with the Tsunami Generator are also presented.



MULTI-HAZARD ASSESSMENTS FOR BUILDING SUSTAINABLE AND RESILIENT COMMUNITIES IN THE PHILIPPINES

Duncan, M. (1); Edwards, S. (1); Twigg, J. (1); Edwards, M. (2); Mercer, J. (2); Kilburn, C. (1) and Rossetto, T. (3)

(1) Aon Benfield UCL Hazard Research Centre, Department of Earth Sciences, University College London, Gower Street, London, WC1E 6BT

(2) Catholic Agency for Overseas Development, Romero Close, Stockwell Road, London, SW9 9TY

(3) Department of Civil, Environmental and Geomatic Engineering, University College London, Gower Street, London, WC1E 6BT

Contact Email: melanie.duncan@ucl.ac.uk

Two key themes for enhancing the effectiveness of building resilience in vulnerable communities are the development and implementation of (1) procedures for reducing the risk from natural hazards, and (2) strategies for enhancing adaptation to climate change. These two themes are intimately related. However, observation of recent practice among non-governmental organisations (NGOs) suggests that they are being addressed independently. There is thus a need to establish an efficient and integrated approach to mitigating the consequences of natural hazards and climate change.

The aim of this research is to develop multi-hazard assessments that can be used by NGOs for building sustainable and resilient communities in the context of Disaster Risk Reduction (DRR) as well as of Climate Change Adaptation (CCA). The research does not downplay the important threat that climate change poses to human security. Rather, it aims to illustrate that climate change must be rigorously assessed relative to other hazards at appropriate scales of both space and time before being considered a priority by NGOs. To this end, this research will initially focus on an in-depth evaluation of current NGO methods for DRR and CCA assessment, which will consider (a) how NGOs assess risk, (b) how scientific multi-hazard assessments can be used to inform policy and decision-making, and (c) how these assessments can effectively incorporate local knowledge. The results will be used to inform strategies, so that NGOs, and the communities they work with, have the opportunity to holistically analyse threats to human security and, through informed decision-making, increase their resilience to such threats.

The Philippines has been chosen as the site of study as it represents a truly multi-hazard (including climate change) environment, which is also suffering from intense environmental degradation. The outputs of the research, however, aim to have wider geographical applicability.



SESSION 3: ASSESSING VULNERABILITY, RESILIENCE AND CAPACITY

Chair: John Twigg, Aon Benfield UCL Hazard Research Centre, University College London

ORAL PRESENTATIONS

NO RISK PLEASE: WE'RE BRITISH

Bankoff, G.

Department of History, University of Hull

Contact Email: g.bankoff@hull.ac.uk

As someone who has worked with the notions of vulnerability, resilience and capacity in developing countries over the years and moved to Hull just in time for the floods of summer 2007, I was struck by the way these concepts were discussed and put into practice (or not as the case may be) in a UK setting. Until recently, there seems to have been a strange reluctance to think that such notions really applied here or to interpret them more as technical terms relating mainly to the physical and built environment. This paper gives me the opportunity to look at the developed world through the conceptual lens of the developing.

I want to do this, however, in a somewhat idiosyncratic way that reflects my own disciplinary background as a scholar whose principle interests in hazards and disasters lie in history and culture. These may seem strange bedfellows, especially for those unfamiliar with my work, but people's vulnerability, resilience and capacity are quintessentially historical conditions that require interrogating the past and paying due attention to culture to fully understand and prepare for. It is what I call the "inherent" or "residual" vulnerability, resilience or capacity of a community/society and provides the context within which all events are played out.

Casting British society in this light, I hope, will throw a different complexion both on the nature of risk perception and the culture of complacency that seems to have pervaded civil defence and emergency management in this country.



MAPPING VULNERABILITY AND RESILIENCE IN EASTERN NEPAL: AN INTERDISCIPLINARY APPROACH

Sudmeier-Rieux, K.

University of Lausanne, Faculty of Earth Sciences and Environment

Contact Email: karen.sudmeier-rieux@unil.ch

This paper describes a study of highly vulnerable communities in rural Eastern Nepal, severely affected by seasonal monsoon-triggered landslides and flooding. We present an interdisciplinary method for integrating social science-based work with a physical study of risks faced by landslide-prone communities. The last large earthquake to affect this region was in 1988, triggering numerous large landslides. However, most of the landslides are small, shallow, frequent landslides and are greatly affecting rural lives and livelihoods. They are not captured by headlines or official statistics but are examples of cumulative, hidden disasters, which are increasing in frequency and are part of everyday life in the Himalayas. Mitigation is usually limited to local observations of landslide movement, minor physical and vegetative mitigation methods and subsequent abandonment of houses and land as they become too dangerous. As monsoon rainfall patterns change, more intense rainfall events are increasing the occurrence of landslides, which cause annual casualties, blocked roads, lost agricultural lands and livelihoods.

Our study is based on an interdisciplinary approach to understanding the complex interactions between land use, landslides, and the multiple dimensions of risk, vulnerability and resilience. Our approach sets out to understand underlying social, ecological and physical risk factors intensified by the increasing number of landslides in Eastern Nepal. By approaching the issue of landslides from multiple angles, social and physical: risk perceptions, resilience, local coping capacities, geological processes, land use patterns, and multiple research techniques, such as remote sensing, GIS, risk assessments, participatory risk mapping and focus groups, we are better able to create a more complete picture of the “hazardscape”. We are exploring innovative ways of mapping vulnerability and resilience, based on communities’ perceptions of these concepts. Our goal is to keep this method relatively simple, low cost and useful to decision-makers and communities for managing and designing integrated development and risk management approaches under changing climate conditions. After presenting our findings, we conclude with observations, obstacles and ideas for future research.



COMMUNITY VULNERABILITY AND CAPACITY IN POST-DISASTER RECOVERY: THE CASES OF MANO AND MIKURA NEIGHBOURHOODS IN THE WAKE OF THE 1995 KOBE EARTHQUAKE

Yasui, E.

Department of Applied Disaster and Emergency Studies, Brandon University, 270-18th Street, Brandon, Manitoba, R7A 6A9, Canada

Contact Email: yasui@brandonu.ca

This study examines the recovery process of two small communities in Japan following the 1995 Kobe earthquake. The study focuses on the relationship between community vulnerability to disaster, and the capacity to influence community vulnerability. Disasters occur where vulnerable populations are present. Therefore, reducing vulnerability is critical to minimizing the risk to future disasters. Previous studies have suggested that disaster vulnerability can be reduced through an existing capacity (or adaptive capacity) to manage risks, and that vulnerability and capacity are inversely related, meaning that as capacity increases, vulnerability decreases. Intriguing research questions arise from the aftermath of the Kobe earthquake. Do communities with high capacity recover well because their vulnerability is reduced? Does high community vulnerability obstruct the recovery process? Do communities with low capacity for recovery fail to overcome such obstructions? How are vulnerability and capacity related to each other? Adopting Blaikie et al.'s Pressure and Release Model (1994 and 2004), I examine the nature of the vulnerability-capacity relationship before, during, and after the Kobe earthquake in the small neighbourhoods of Mano and Mikura. I look specifically at the recovery processes of the two communities and their attempts to improving safety and quality of life. Although both communities reduced vulnerability and improved their capacity for disaster recovery following the earthquake, the long-term sustainability of the two communities remains uncertain: issues and challenges such as residual and newly emerging physical vulnerability, negative or slow population growth, and an aging society are creating greater vulnerability to future disasters. The interactions of community vulnerability and capacity are highly complex and contingent on many contextual considerations, such as the effectiveness of social and physical planning, community economic and environmental sustainability, and the achievements of community-based organizations.



(RE)PRODUCTION OF DISASTER RISK REDUCTION?

Johnson, C.; Boano, C. and Allen, A.

Development Planning Unit, University College London

Contact Email: cassidy.johnson@ucl.ac.uk

It is widely acknowledged that the urban poor in cities of the global south are extremely vulnerable to hazards. However, a closer look at these communities suggests that the urban poor also employ social, economic and physical coping strategies to build their resilience to hazards. Thus, planning for disaster risk reduction and adaptation at the local level needs to incorporate not only the understanding of vulnerability, but also of resilience and capacity.

This presentation aims to explore the interaction of vulnerability, resilience and capacity using three levels of inquiry: First of all on the ground, at the grassroots level, we explore how people are actually dealing with disasters and what they need to improve their ability to cope. Secondly, at the level of the political economy, we examine how and why built-in resilience is undermined by local and national level political economy. Thirdly, at the level of the meta-discourse, we take a critical stance to the catch-phrases, 'vulnerability, resilience and capacity' as western-northern-based knowledge; thus talking the question, on what assumptions do we base built-in resilience?

The presentation will draw on empirical work in Dhaka, Bangladesh, as well as other cities of the global south.



IMPACTS TO AGRICULTURE FOLLOWING THE 1991 ERUPTION OF VULCAN HUDSON, PATAGONIA: LESSONS FOR RECOVERY

Wilson, T.M. and [Cole, J.W.](#)

Natural Hazard Research Centre, University of Canterbury, Private Bag 4800, Christchurch 8140, New Zealand

Contact Email: jim.cole@canterbury.ac.nz

Large explosive eruptions have the potential to distribute heavy ashfalls across large areas, resulting in physical and chemical impacts to agriculture, and economic and psycho-social impacts to rural communities. This study investigates how affected agriculture and rural communities have adapted, absorbed, and mitigated impacts following heavy ashfalls from the 12-15 August 1991 eruption of Vulcan Hudson, one of the largest eruptions of the 20th century. An estimated 1 million livestock died after the eruption following pasture burial by ashfall and on-going suppression of vegetation recovery. Horticulturalists suffered on-going damage to crops from wind-blown ash and changes to soil properties increased irrigation and cultivation requirements. Real or perceived impacts to human health and impacts to farm productivity from the ashfall resulted in evacuation of farms and small towns in the short-term. Long-term farm abandonment occurred in areas of heavy ashfall (upper Ibáñez valley) and highly stressed farming systems, even where ashfall was relatively thin, such as the Argentine steppe. The mono-agricultural system of sheep farming in the steppe region had few options other than destocking, proving less resilient than the diverse high-intensity horticultural and pastoral mix in irrigated valleys, which allowed more rapid adaption through diversification. Farms with natural advantages and greater investment in capital improvements led to greater damage potential initially, but ultimately provided greater capacity for response and recovery. Better soils, climate and significantly greater access to technological improvements such as cultivation tools, irrigation and wind breaks were advantageous, such as at Chile Chico (Chile), Los Antiguos and Perito Moreno (Argentina). Cultivation increased chemical and physical soil fertility, especially when used in combination with fertilisation and irrigation. Appropriate use of seeds and cropping techniques within the new soil and growing conditions was important. Government agencies had a vital role in the dissemination of information for appropriate farm management.



ASSESSING RISK IN ZIMBABWE: REFLECTIONS ON THE RISK ASSESSMENT PROCESS

Buckle, P.

Monash International Initiative for Community Resilience and Aon Benfield UCL Hazard Research Centre

Contact Email: philip.buckle@gmail.com

An assessment of community risk to natural and non-natural hazards in Masvingo Province in Southern Zimbabwe has been undertaken in an effort to better target and manage the services of International Non-Government Organisations. This assessment involved an extensive literature review, interviews with INGO staff, interviews with Government officials, donor agencies and focus group and interview sessions with local people including community leaders, traditional leaders, women's groups and village groups.

The results of this assessment process showed that local communities are exposed numerous simultaneous hazards, including drought, storms and floods, endemic disease such as malaria and HIV/Aids, chronic food shortage, soil erosion and attacks by wild animals. In addition the breakdown of social and physical infrastructure including agriculture, education, health services, telecommunications and public transport as well as the emigration of a large cohort of young adults. This set of impacts is compounded by the failure of cash as a medium of exchange because of hyperinflation.

This countrywide concatenation of impacts means that there is no single or simple intervention that will significantly reduce the risks faced by local people. A new approach is required to understand, assess and manage risk that moves beyond a linear cause and effect model and which assesses simultaneous causal pathways and which enables first remediation and stabilization of at risk communities and then supports sustainable risk management over many years. However, such risk management may have to accept that 'things will get worse before they get better' and that new approaches will be required given the collapse of the monetary system, institutions and infrastructure; in essence nation rebuilding will have to occur and this in turn will require a much closer alignment of risk management, development (over multiple sectors), governance and resource management



POSTER PRESENTATIONS

THE CONCEPTUAL MAPS AS INNOVATIVE TOOLS FOR ASSESSING VULNERABILITY TO COMPLEX HAZARDOUS EVENTS: THE CASE OF HURRICANE KATRINA

Profice, A.S. and Galderisi, A.

Department of Pianificazione e Scienza del Territorio, University of Naples Federico II, P.le Tecchio 80, 80125 Naples

Contact Email: andrea.profice@unina.it

At present many disasters, mainly the ones affecting big urban areas, are due to one or more natural hazardous events triggering one or more technological accidents. Such events, which can be defined as “complex hazardous events” (CHaE), are characterized by: (1) heterogeneity of hazardous sources (natural or technological); (2) a tight coupling nature of natural and technological “spheres” within the space and time; (3) a post-impact damage scene characterized by damages to all sort of territorial elements (people, buildings, natural resources, etc.). Hence, policies and tools aimed at understanding and managing CHaE must recognize such inherent complexity. On the contrary, current approaches to risk evaluation usually focus on one type of hazard and vulnerability analysis, grounding on a hazard-oriented approach, are generally focused on structural characteristics of buildings and infrastructures, sometimes dealing with social and economic aspects. To overcome the main gaps in current approaches to vulnerability analyses, mainly in the case of CHaE, this paper - based on a research work developed within the European Project “Enhancing resilience of communities and territories facing natural and na-tech hazards” (ENSURE) - provides an innovative approach to vulnerability analyses. In detail, vulnerability has been analyzed as an emerging property both from physical, socio-economical, institutional fragilities of all the affected elements and systems and from their relationships. In order to handle such complexity, a conceptual map has been developed and applied to a selected case study with a twofold aim: (a) to achieve a better understanding of “complex hazardous events” and of the many interrelated aspects of vulnerability of heterogeneous territorial targets to such events; (b) to support strategies of risk prevention and mitigation, including risk-aware land use planning policies. The selected case-study is the Hurricane Katrina (New Orleans, 2005), which represents a paradigmatic example of CHaEs.



DYNAMIC, PARTICIPATORY, VULNERABLE SUB-GROUP FOCUSED AND REPLICABLE FOOD AND LIVELIHOOD SECURITY ASSESSMENTS: TOWARD A SUSTAINABLE COMMUNITY RISK REDUCTION AND DEVELOPMENT SYSTEM

Alexander, B.

Rural Livelihood Risk Management Consulting, Honolulu, HI, USA

Contact Email: bfootbob@hotmail.com

Inappropriate rural development and disaster risk reduction policies often result because of a fundamental lack of understanding of the communities' food and livelihood conditions and their underlying vulnerabilities, capacities, and resilience. Although food and livelihood security assessment methodologies have been developed to better assess baseline and adverse year insecurity potential, these methodologies continue to lack adequate predictive techniques that will enable stakeholders to improve the local food and livelihood systems based on expectations of future, rather than past, vulnerabilities, resilience, and capacities.

Although some rural areas may be facing a future quite similar to its recent past, many are in the midst of significant environmental, social, and economic change trends that could be incorporated into analysis for more insightful assessments. Additionally, since the resulting treatment decisions are aimed at reducing future losses, such assessment methodologies would benefit from an ability to dynamically assess the potential impacts of these changes. This paper develops the foundations for a quantitative and qualitative food and livelihood insecurity assessment methodology that meets the key criteria of being dynamic, participatory, focused on differences in insecurities according to community subgroups, and replicable as part of a sustainable community risk reduction and development system. After discussion of merits of different elements of different current methodologies, elements of the Household Food Economy assessment approach are illustrated in a case study from Timor Leste. This approach is then modified to better meet the key criteria with a simulation showing some of the potential for use of this dynamic approach in future assessments.



ANALYSING THE SPATIAL DISTRIBUTION OF VULNERABILITY TO FLOODS IN THE SALZACH CATCHMENT, AUSTRIA

Kienberger, S.; [Contreras, D.](#); Zeil, P. and Lang, S.

Centre for Geoinformatics (Z_GIS), Salzburg University, Schillerstrasse 30, 5020 Salzburg, Austria

Contact Email: stefan.kienberger@sbg.ac.at or dianamaria.contreras-mojica@sbg.ac.at

In the context of the EU funded research project BRAHMATWINN (<http://www.brahmatwinn.unijena.de/>) a method has been developed to spatially model the socio-economic vulnerability to floods. The approach has been implemented in the Salzach catchment in Austria. The area is generally prone to floods as the Salzach River is one of the most regulated rivers in the Europe. In an initial step, vulnerability has been defined following the IPCC specifications, but has been adopted to meet requirements to allow a practical implementation. Therefore vulnerability is defined as a function of sensitivity and adaptive capacity, whereas adaptive capacity constitutes elements of social capacity and resilience.

The major aim has been the development of spatial vulnerability units (VulnUs), which represent a spatial homogenous area of vulnerability. This approach follows different conceptualisations emerging from landscape ecology and object-based image analysis. Specific and suitable indicators have been identified together with local experts and stakeholders to describe the different elements of the vulnerability function. Data sources emerge from governmental spatial data infrastructures and the gridbased results of the Austrian census, which allow the spatial disaggregated integration of population data. In a further step, local stakeholders and experts have been identified to weight the different indicators (Delphi approach). The weights are being integrated to model sensitivity, adaptive capacity and vulnerability respectively. Methods applied include weighted linear combination and regionalization algorithms for spatially integrating multidimensional geodata. As a result, spatial units have been identified which represent common characteristics of vulnerability.

The methodology allows a spatially explicit, disaggregated representation of vulnerability not constrained by administrative units. Next to that, different domains and indicators can be decomposed and mapped independently. One critical point remaining is the validation of complex approaches such as socio-economic vulnerability. However, the approach developed is one step ahead to allow the monitoring of vulnerability over time and within domains, and to provide decision makers with policy relevant information.



SPATIAL VULNERABILITY INDICATORS APPLIED TO RECOVERY AND RISK REDUCTION AFTER EARTHQUAKES: THE CASE OF L'AQUILA - ITALY

Contreras, D.; Zeil, P. and Kienberger S.

Centre for Geoinformatics (Z_GIS), Salzburg University, Schillerstrasse 30, Salzburg 5020, Austria

Contact Email: stefan.kienberger@sbg.ac.at or dianamaria.contreras-mojica@sbg.ac.at

Vulnerability assessment is a key contribution to formulate recovery and development policies in the risk management process. The post-disaster phases present the opportunity to address the pre-existent vulnerability conditions in order to reduce the risk, and create more resilient societies. The aim of this research is to construct a methodology for monitoring and evaluating the recovery and reconstruction process after earthquakes, based on a framework of spatial vulnerability indicators beyond the physical aspect. The research aims to find the correlation between vulnerability conditions and the dynamics of relief, recovery and development processes and to know which other factors influence the interventions during post-disaster phases. The methodological approach relies on spatial indicators but the idea is to construct an index, which is not only based on physical patterns but also on the social, economical, institutional, cultural and environmental dimensions. The case study area is L'Aquila (Italy), which was shaken by the 6th of April 2009 earthquake. Additionally, key elements could also be extrapolated from the experience collected so far in Bogotá D.C. (Colombia), since this city is currently working on its pre-impact recovery planning. The research is divided in five phases. The first one consist of the literature review of the concepts, previous experiences, best practices, indicators theory, vulnerability assessment, post-disaster activities, the application of remote sensing, GIS techniques and statistics methods. The second phase corresponds to the fieldwork, which is divided into four activities: discussions with the key stakeholders, observation of the local conditions, surveys among affected population and collection of spatial data. The last three phases correspond to the analysis using tools and techniques according to the specific topic to be analyzed, the explanation and discussion of the results and the conclusion and recommendations to improve future recovery processes



RESILIENCE UNDER THE MAGNIFYING GLASS

Verrucci, E. and Rossetto, T.

EPICentre, Department of Civil, Environmental and Geomatic Engineering, University College London, Gower Street, London, WC1E 6BT

Contact Email: e.verrucci@ucl.ac.uk

In the field of Disaster Risk Reduction, the term resilience has gained high recognition and it is now widely used in many disciplines. This has produced two counter-balancing effects. On the one hand, it is a great advantage to the scientific community to explore different perspectives on the topic; on the other hand, the copious number of definitions in the literature hinders its application in research or practical measurement.

The history of natural disaster science is filled with paradigms describing resilience that have paved the evolution of the current research on the topic. Although each school of thought has some evident benefits, each approaches the topic in a mono-disciplinary way, concentrating on one or two particular aspects of resilience only.

The paper reviews the key paradigms in disaster science in order to prove that the introduction of the term resilience in the DRR field represented a means to bridge gaps between different disciplines, by acknowledging the pros of opposite outlooks in order to set a common point from which each discipline could move forward. In this context, resilience becomes the ideal tool to evaluate community capacities in a multi-disciplinary context. Key indicators to assess resilience are also reviewed in the paper; introducing how remote sensing and GIS techniques can help in the assessment.



USE OF FREE SATELLITE IMAGERY FOR DISASTER RISK REDUCTION

Morris, N.J. and Teeuw, R.M.

Geohazard Research Unit, School of Earth and Environmental Hazards, University of Portsmouth, Burnaby Building, Burnaby Road, Portsmouth, Hampshire, PO1 3QL

Contact Email: naomi.morris@port.ac.uk

The increased number and scale of natural disasters in recent years has resulted in loss of life and long term negative social, economic and environmental impacts, particularly in developing countries. Hazards are processes which occur in the natural environment and damage human life, property, or both. Vulnerability is comprised of the people in their environment and their exposure to hazards. Disaster Risk is dependent on the severity of associated hazard and vulnerability.

The impact of natural hazards can be reduced by using disaster preparedness maps. Regional “pre-disaster” maps show areas of high risk, which can then be assisted with disaster mitigation measures, such as clearing paths to areas of safety and publicity to increase local hazard awareness. Taking these measures and targeting high-risk areas can save lives and prevent damage, as well as providing better guidance on where to place early warning systems.

This research will examine the effectiveness of satellite imagery for mapping disaster risk, through a combination of geohazard inventory maps, vulnerability maps (populated areas, land cover types, particularly habitations, infrastructure and natural resources) and hazard event chronologies.

Assessment will be made with the use of free satellite datasets, aerial photography, geological maps, topographical maps and ground surveys, whilst also evaluating the local awareness of disaster risk. The effectiveness of freely available GIS software will be tested against commercially available software.

Pilot studies have already been carried out for communities in NW Costa Rica, Dominica, Papua New Guinea and Tanzania: the various methodologies will now be tested on study regions in Sri Lanka, before and after the 2004 tsunami, comparing pre-tsunami predictive maps with the actual impacts.



A CAPABILITY APPROACH FOR REDUCING POTENTIAL LOSSES FROM NATURAL DISASTERS

Yorulmaz, N.

Business School, Brunel University, UB8 3PH

Contact Email: nermin.yorulmaz@brunel.ac.uk

How do you combat a natural disaster? Man has ways to combat life threatening situations, but when it comes to natural disasters man is often powerless. Even today, the destruction and carnage caused by a natural disaster is far higher than any damage that man could do (e.g. mentally scarred). While disaster can strike in minutes, it often takes years or a life time to recover from the physical and psychological damage that such largely unforeseen events bring to mankind.

In spite of the fundamental role that natural disasters place in the advent of civilization, human understanding of the consequences of such events is somewhat lacking. While aid, support or assistance can be provided after the aftermath of such life changing events, men often overlooks the critical need to respond to the overall long term effects on society that such environmental disasters bring about rather than short term reactionary measures that humans often employ based on immediate humanitarian needs of those affected by tragic circumstances as opposed to the more long term consequences to lives that such disasters cause.

In order to assess the burden, inhabitants' face, when a disaster strikes, the attention should not be only on income but also their changing options (capabilities). For better targeted help, governments and NGOs should be able to distinguish citizens that are in negative situations (adverse state) as a result of their choices (volition). Capability Approach (Sen, 1985) is adopted to identify the change of needs of individual well-beings for a better targeted help on immediate aftermath, short time and long term.

This project aims to capture the complex relationships (transformation) between different levels of people's well-beings in order to (i) direct the pre-emptive actions in case of disasters, (ii) inform policy decision-making. In accord with this, in this project we will be adopting a new approach for reducing people's vulnerabilities that is both complimentary to disaster management and progressive in its consideration of human centred perspectives.



MAINSTREAMING LOCAL PERCEPTIONS OF HURRICANE RISK INTO POLICYMAKING: A CASE STUDY OF COMMUNITY-BASED VULNERABILITY MAPPING IN MEXICO

Krishnamurthy, P.K.

Environmental Change Institute, Oxford University

Contact Email: Prasanna.Krishnamurthy@ouce.ox.ac.uk

The present research was conducted in 2009 with the aim of exploring the potential for incorporating local perceptions of disaster risk (particularly hurricane vulnerabilities) into policymaking. This paper proposes that linking community participation with modern techniques to analyse risk can empower communities and mobilise their capacities. In doing so, this research discusses the use of participatory geographical information systems (GIS) hazard mapping to highlight information of local vulnerabilities. This is done through a case study of El Zapotito commune in the State of Veracruz, located on the Atlantic coast of Southeastern Mexico.

The paper proposes a mathematical model of vulnerability based on the information obtained through interviews with the community of El Zapotito. With these data, the current vulnerabilities of households in El Zapotito are examined through a vulnerability map. The results indicate patterns of vulnerability closely linked to domestic infrastructural weaknesses. These findings are corroborated by a vulnerability and capacity assessment (VCA), which suggests that people have limited coping mechanisms to deal with unsafe housing.

The advantages, disadvantages and lessons learnt from the participatory GIS hurricane risk mapping are discussed. An important challenge remains in updating and expanding databases for vulnerability research; a website is developed in partnership with the University of Chapingo, Mexico, to facilitate future research. In concluding, this paper recommends actions for communities and governments to reduce disaster risk at the local level.



EFFECTS OF CLIMATE CHANGE ON COASTAL MANAGEMENT, BUSINESSES AND COMMUNITIES IN THE SOLENT

Percival, S. E. and Teeuw, R. M.

School of Earth and Environmental Sciences, University of Portsmouth, Burnaby Building, Burnaby Road, PO1 3QL

Contact Email: sarah.percival@port.ac.uk

This is an assessment of the effects of climate change on coastal management, businesses and communities in the Solent, paying particular interest to the island city of Portsmouth, Hayling Island and Havant district.

Only when coastal hazards and human activity are in conflict, do hazards such as flooding and coastal erosion become a threat to the community. As urban development increases, intensifies or spreads into hazardous areas, the potential impact of hazards increases, thereby increasing risk.

This study examines the social, environmental and economic assets at risk, firstly using different maps from Ordnance Survey, historical flooding data from the British Geological Survey, and expected flooding data up to the year 2115 from the Partnership for Urban South Hampshire (PUSH) Strategic Risk Flood Assessment. Secondly, using preliminary collation of 'asset' data that has been processed by GIS software to produce predictive maps showing the distribution of those impacts.

This assessment will be taken further by continuing to collate 'asset' data into the GIS, which will then be used to produce predictive maps that will show the distribution of those impacts. A review will then take place of the current vulnerability assessments and contingency planning for emergency management in the study areas. From these reviews a 'gap analysis' will be made between the emergency planning and emergency response for coastal flooding, leading to a set of 'best practice' guidelines.



COMMUNITY BASED NATURAL HAZARD MITIGATION IN KYRGYZSTAN

Romanenko, T.

Scott Wilson Ltd, Environment & Natural Resources, Scott House, Alençon Link, Basingstoke, RG21 7PP

Contact Email: tanya.romanenko@scottwilson.com

The rural communities in the Kyrgyz Republic are frequently affected by various natural hazards. These include earthquakes, landslides, flash floods, strong winds, droughts, snow avalanches, elevated groundwater and erosion. These hazards pose major risks to local communities, particularly the poor, their livelihoods, infrastructure and economies. The capacity for disaster risk reduction initiatives at community level remains low. The communities are familiar with 'inherited' top-down approaches to disaster mitigation planning, and they find it very difficult to understand that community-based disaster risk reduction initiatives and social changes can help to enhance their safety. This can be achieved through the reduction in vulnerability and strengthening of community resources to combat hazards. Furthermore, there is no culture of safety within the communities, whereby the communities a) are fully aware of the hazards that pose risk to them b) know how they can mitigate the hazards utilising the available resources and, most importantly, c) are willing to partake in activities aimed at risk reduction.

This paper presents the approach taken to identify the ten poor communities most affected by natural hazards, and the pilot projects undertaken in each of them these hazards. These projects that were implemented by the communities themselves involved institutional measures that included the set-up of community based organisations, engineering and construction works, social measures that included public awareness education, and economic provision for recovery.



PRACTICALITIES OF VULNERABILITY ANALYSIS: LESSONS FROM ST. VINCENT, CARIBBEAN

Lowe, C.J. (1); Haklay, M. (2); McGuire, W.J. (1); and Robertson, R.E.A. (3)

(1) Aon Benfield UCL Hazard Research Centre, University College London, Gower Street, London, WC1E 6BT

(2) Department of Civil, Environmental and Geomatic Engineering, University College London, Gower Street, London, WC1E 6BT

(3) Seismic Research Centre, University of the West Indies, St. Augustine, Trinidad, West Indies

Contact Email: c.lowe@ucl.ac.uk

Volcanology and volcanic risk assessment have in the past been dominated by pure physical science and the study of hazard mechanisms. Traditional vulnerability analyses undertaken at volcanoes have focused on the physical vulnerability of buildings to collapse and the probabilities of loss of life given exposure to a volcanic hazard. This alone, however, cannot explain losses from historical volcanic eruptions. We know there is a strong vulnerability component to volcanic disasters including political influences, communication and the ability of the populations to cope and respond. In addition, it is evident from the literature that vulnerability to natural hazards is multifaceted. It is complex and diverse with stakeholder groups having different views of vulnerability and individual needs with respect to conducting vulnerability analyses. The literature is awash with definitions, models and methods for vulnerability analysis, and this makes the practical task of conducting a vulnerability analysis all the more complicated.

Research into vulnerability from volcanic hazards on the island of St. Vincent in the eastern Caribbean has utilised four different methods to conduct a vulnerability analysis (social vulnerability mapping, building vulnerability survey, stakeholder mental maps, and historical vulnerability analysis) in order to enable the researcher to compare and contrast the results, and appraise the different models and methods. Stakeholders in disaster management on the island have been central to the research, determining what indicators of vulnerability are included in the analyses. The results show that:

- no single model or method is able to capture all elements of vulnerability that are important to the stakeholders;
- areas of high social vulnerability do not coincide with areas of high building vulnerability; and
- proximity to the volcanic hazard was the most common vulnerability factor identified by stakeholders and their mental maps of vulnerability mirrored the existing integrated hazard map for the island.

Only by applying a range of different methods for vulnerability analysis at one location is one able to appraise the models and methods, compare the geography of the different elements of vulnerability captured, and ascertain the most practical and appropriate tool for stakeholders.



DAY 3: FRIDAY 6TH NOVEMBER

SESSION 4: CULTURAL PERCEPTIONS OF HAZARD AND RISK

Chair: JC Gaillard, University of Grenoble & University of the Philippines and Jessica Mercer, CAFOD

ORAL PRESENTATIONS

CULTURAL PERCEPTIONS OF HAZARD AND RISK

Mercer, J.

Catholic Overseas Development Agency (CAFOD)

Contact Email: jmercerc@cafod.org.uk

“You need to move up into the mountains away from the river”

These were the words of a government official to a Papua New Guinean community who suffered from the effects of flooding every year and were requesting assistance.

Clearly there was no understanding of the community dependence upon the river for their livelihood or of their cultural setting as these were their ancestral lands passed down through generations. The solution was simple and clear for all to see on the surface but perhaps not so underneath; the issues clearly involve much more than this.....so how do we engage with culture and ensure its incorporation into disaster risk reduction (DRR)?

This brief overview for this session reflects upon four key questions:

1. How relevant is ‘culture’ to disaster risk reduction?
2. How do we engage with culture?
3. What is the value of indigenous knowledge and how can we access/utilise this for DRR?
4. Where do the challenges lie in putting research into practice with regards to culture and DRR?



TRADITIONAL LAND OWNERSHIP PATTERNS, VULNERABILITIES AND RESILIENCE IN CAPE VERDE AND PAPUA NEW GUINEA: CONSEQUENCES FOR DISASTER MITIGATION STRATEGIES

Day, S.

Aon Benfield UCL Hazard Research Centre, Department of Earth Sciences, University College London, Gower Street, London WC1E 6BT

Contact Email: simonday_ucl@yahoo.co.uk

Governments and aid agencies are prone to “top – down” disaster responses that come into conflict with the very people that they mean to help. Such conflicts often result from a failure to understand patterns of land ownership that differ from the Western norm of individually owned but transferable property, and the consequences for the vulnerabilities and resilience of traditional communities. Here I discuss the very different patterns and histories of land ownership in two different societies, and the consequences for disaster mitigation strategies in these countries.

In Papua New Guinea, traditional or “custom” land ownership is based upon collective ownership by villages or tribes of areas within which shifting, slash-and-burn agriculture is practiced by the families making up these communities. Such communities find it easy to mitigate hazards with restricted impact zones (notably tsunamis) by moving their housing within their custom lands. In contrast, evacuation of custom lands during volcanic eruptions are extremely damaging to these traditional communities, as they have no means of acquiring new custom land rights and become completely dependent upon outside aid. Acceptance of the risks of remaining within hazard zones during eruptions may therefore be preferable to even temporary evacuations.

Rural communities affected by the 1995 eruption of Fogo, Cape Verde show a different pattern of vulnerability and resilience. Land rights in Cape Verde are linked to complex family networks: whilst each nuclear family owns and is strongly attached to particular inherited plots of land, support in emergencies such as the 1995 eruption is provided by very extended family networks that may spread across the island and into the expatriate Cape Verdean communities. Since the eruption the majority of the evacuees have rejected the resettlement housing built for them, and have returned home to their remaining lands despite the destruction caused by lava flows.



MAPPING CULTURAL VULNERABILITY FOR HOLISTIC RISK ASSESSMENT: FINDINGS FROM MT MERAPI VOLCANO, INDONESIA

Donovan, K.

School of Geography, Earth and Environmental Sciences, University of Plymouth, Portland Square, Drake Circus, Plymouth, PL4 8AA

Contact Email: katherine.donovan@plymouth.ac.uk

In 2006 a new lava dome growing rapidly at the summit of Mt Merapi (Indonesia) ,partially collapsed sending fatal pyroclastic flows down the southern flank of the volcano. Approximately 300m from the flow path Mbah Marijan and his family watched the burning clouds race past their home. Despite government efforts, this 'gate keeper of the volcano', had refused to evacuate, along with many thousands of people living on this extremely active volcano.

As part of my doctoral research, in 2007 I undertook a survey of two settlements on Mt Merapi's southern flank which concluded that traditional customs and beliefs did played a part in evacuation failure at the volcano. The findings indicated that many remained because they were waiting for traditional signs and without these they saw no reason to disrupt the lives. Moreover, they feared their livestock would starve and their belongings would be stolen if they were to evacuate, leaving them with nothing. The survey results strongly implied that the more culturally intense a region, the more likely it was to refuse to evacuate, suggesting that local culture is making the people at Mt Merapi more vulnerable.

To examine this *cultural vulnerability* further a second spatially extensive survey was carried out in 2009. The new survey findings are reported here in the form of maps that can be integrated into conventional risk assessments and disseminated amongst local scientists and emergency managers. In a broader context, the research demonstrates that cultural vulnerability is an important yet understudied element of risk reduction, and it suggests novel ways in which '*social volcanology*' research (e.g. Donovan 2009) can find new ways of incorporating conventionally 'unquantifiable' information into vulnerability assessments and risk maps.

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HOW ROBUST ARE SCIENCE-BASED DISASTER PREPAREDNESS STRATEGIES? LESSONS FROM WESTERN SUMATRA

Shannon, R.; McCloskey, J. and McDowell, S.

University of Ulster

Contact Email: shannon-r@ulster.ac.uk

Forecasts of the next likely megathrust earthquake off Sumatra's western coast, possibly in the near future, indicate that it may be tsunamigenic. Simulations of potential earthquakes and their tsunamis show that, while the earthquake is unpredictable, many scenarios would see dangerous inundation of low-lying areas along the west coast of Sumatra; the cities of Padang and Bengkulu broadside-on to the areas of highest seismic potential have a combined population of over one million. Understanding how the science of unpredictable, high probability events is absorbed by society is essential for developing effective mitigation and preparedness campaigns. A five month field investigation conducted in Padang and Bengkulu aimed to conceptualise the main issues driving risk perception of tsunami hazard, and explore its influence upon preparedness.

Target populations were adult community members ($n=270$) and students ($n=90$). Preliminary findings indicate that scientific knowledge of earthquake and tsunami threat is good. However the relationship between respondent's hazard knowledge, desired risk perception, and the adoption of preparedness measures was often non-linear and is susceptible to negative effects of unscientific forecasts. Evidence suggests 'mystic' predictions often portrayed in the media as being scientific, have been readily absorbed by the public; when these fail to materialise the credibility of authentic science and scientists plummets. Resultantly levels of sustainable earthquake and tsunami preparedness measures can be detrimentally impacted. It is imperative that the accredited science of high probability, unpredictable natural hazards prevails within public consciousness in western Sumatra, despite the frequent circulation of unsubstantiated predictions and claims relating to these events. While management of this information ultimately lies with government, the recent past has dictated a need for scientists to become more proactive in ensuring their work is accepted as a foremost source of knowledge used to guide accurate risk perceptions and stimulate the adoption of appropriate preparedness measures.



PARTICIPATORY THREE-DIMENSIONAL MAPPING FOR COMMUNITY-BASED DISASTER RISK REDUCTION

Gaillard, J.C. (1) and Maceda, E.A. (2)

(1) UMR 5194 Pacte - CNRS, University of Grenoble, 14 bis Avenue Marie Reynoard, 38100 Grenoble, France / Department of Geography, University of the Philippines, Diliman Campus, Quezon City 1101, Philippines

(2) Department of Geography, University of the Philippines, Diliman Campus, Quezon City 1101, Philippines

Contact Email: jean-christophe.gaillard@ujf-grenoble.fr

One of the most pressing challenges for enhancing Community-Based Disaster Risk Reduction (CBDRR) is to integrate scientific and indigenous knowledge as well as top-down and bottom-up actions. This presentation documents attempts to achieve such a goal through Participatory 3-Dimensional Mapping (P3DM). P3DM as a tool and method consists of building stand-alone scaled relief maps made of locally available materials over which are overlapped thematic layers of geographical information from indigenous knowledge. Disaster risk-related information which may be plotted on the map include hazard-prone areas, land-use, housing and other infrastructures, households livelihoods, vulnerable individuals (e.g. elderly, ill and disabled individuals, pregnant women, children), prevention and mitigation measures, evacuation routes and shelters. P3DM thus facilitates the interpretation, assimilation and understanding of geo-referenced information by making them visible and tangible to everyone. Because maps are scaled and geo-referenced, P3DM also helps in incorporating scientific knowledge into CBDRR. The integration of P3DM data into Geographic Information Systems (GIS) further contributes to the exploitation of indigenous knowledge beyond the community which built the map and thus enables the convergence of bottom-up and top-down disaster risk reduction measures. The study closes with the identification of obstacles and ways forward in conducting P3DM among communities threatened by various natural hazards. It bases on several experiences from the Philippines which involved a large array of stakeholders, i.e. local communities, NGOs, school pupils, scientists and local authorities.



BRIDGING INSIDER AND OUTSIDER PERCEPTIONS: COMMUNITY VULNERABILITY, RESILIENCE, AND CAPACITY ANALYSIS THROUGH ITERATIVE STAKEHOLDER KNOWLEDGE MAPPING

Alexander, B.

Rural Livelihood Risk Management Consulting, Honolulu, HI, USA

Contact Email: bfootbob@hotmail.com

Increased credence is being given to local knowledge in the disaster risk reduction processes of risk analysis, risk assessment, and risk treatment. Given that any mitigation and adaptation decisions must be acted upon and endured by the community members, optimizing risk reduction through participatory treatment decision-making methodologies has gained significant ground in recent years. Likewise, given that such treatment optimization must be based upon prioritization of unacceptable risk differentials by the local community members, participatory assessment methodologies also generally continue to be viewed more favorably. In order to understand these levels in a risk analysis, knowledge of the different elements of vulnerability, resilience, and capacity must first be defined. Historically, the perceptions of vulnerability of the “inside” people with local expertise have been at odds with the perceptions of vulnerability of the “outside” people with theoretical expertise. Each get frustrated with the others’ inability to grasp the importance of their perceptions, and the result is often ineffective vulnerability reduction because neither donors and agencies nor local residents will invest in treatment that does not address their perceptions of the relevant unacceptable risks.

A proposed solution to this knowledge inconsistency problem is to attempt to bridge these differing perceptions into a commonly agreed-upon set of risk knowledge among all stakeholders as part of the risk analysis process. This paper describes a methodology for iterative stakeholder socio-economic capacity and vulnerability knowledge mapping that initially reveals similarities and differences in perceptions with resultant risk education to all stakeholders resulting in an agreed-upon set of dynamic knowledge from which to base analysis, assessment, and treatment. A case study of participatory capacity and vulnerability analysis relative to impending threats of climate change, disaster threats, and population consolidation in selected islands of the Maldives illustrates elements for consideration in further development and implementation of such methodologies.



POSTER PRESENTATIONS

WILLINGNESS TO PAY FOR ENHANCING LOCAL DISASTER AND EMERGENCY MANAGEMENT SERVICES: CASE OF GREATER TORONTO RESIDENTS

Asgary, A.

Emergency Management, School of Administrative Studies, York University, 4700 Keele Street, Toronto, M3J 1P3, ON, Canada

Contact Email: asgary@yorku.ca

Recent evidences show that despite all efforts, most local governments in Canada are not yet fully prepared for future disasters and emergencies. One important reason behind this lack of preparedness is public finance and budgetary issues. Conditions of fiscal stress in local governments from one hand and public demand for more attention to disaster and emergency preparedness from the other hand prompt researchers and public officials to seek to assess citizens' attitudes about disaster and emergency management services and their inclination to fund enhanced disaster and emergency management services. This study explores the questions of how citizens' attitudes about disasters and DEM services influence their willingness to pay for them and how direct and mediated experience with these services influence attitudes about them.

The paper uses a conceptual model of the relationships between people's exposure to disaster and emergency services, their attitudes about these services, and their willingness to pay for them. The paper present data from a survey of Greater Toronto Area (GTA) households and use these data to estimate the statistical relationship between media exposure and attitudes using regression analysis. The results show that direct experience with disaster and emergency management services and media exposure affect people's perceptions and attitudes and that attitudes predict willingness to pay.



USE OF QUALITATIVE METHODS TO ANALYZE AND EVALUATE THE IMPACT OF AN NGO ON VOLCANIC HAZARD PERCEPTIONS AND DISASTER PREPAREDNESS IN LOS PLANES DE LA LAGUNA, EL SALVADOR

Bowman, L.

Geological and Mining Engineering and Sciences, Michigan Technological University, 1400 Townsend Drive, Houghton, MI 49931, USA

Contact Email: ljbowman@mtu.edu

Recent years have seen an expanding array of studies by volcanologists and social scientists to not only characterize volcanic risk more accurately, but also to characterize hazard and risk perception among peoples residing in potentially hazardous areas (Volcanic Risk Perception and Beyond, JVGR 2008). Risk perception studies to date, however, are predominantly quantitative and of relatively short-term duration. These studies are valuable in that they can compile large amounts of data into statistical generalizations providing an overview of vulnerability in at-risk communities and help decision-makers to design and apply appropriate mitigation efforts (Lopez-Vasquez 2009; Haynes et al 2007 and 2008; McIvor and Patton 2007). However, some intricacies of community dynamics can be missed when using strictly quantitative methods, especially when trying to take into account the response from outside organizations, such as NGOs, and their effects on communities while working to mitigate hazards.

This poster presents results from a five-month-long study conducted in Los Planes de La Laguna, El Salvador—a group of communities impacted in October 2005 by both the eruption of Santa Ana (Ilamatepec) volcano and Hurricane Stan. This research, carried out between January and June 2009, investigated the degree to which hazard mitigation strategies implemented by an NGO affected community hazard perceptions and overall preparedness. In order to capture individual experiences and perceptions, the study used qualitative methods; namely participant observation and 45 in-depth interviews with community members and officials. Contrary to the desired project outcomes in which several infrastructure improvements, educational campaigns, and community-organizing efforts were designed, this research highlights several problems beginning almost immediately after the withdrawal of the NGO. Broader implications show the value of a careful evaluation of NGOs' strategies used to communicate hazard information and highlight the contribution that qualitative data gathering methods can have in understanding ever-changing volcanic hazard perceptions.



SESSION 5: EFFECTIVE COMMUNICATION AND DECISION MAKING

Chair: Tom Mitchell, Institute of Development Studies

ORAL PRESENTATIONS

EFFECTIVE POLICY, DECISION MAKING AND COMMUNICATION FOR NATURAL HAZARDS: A NEW ZEALAND PERSPECTIVE

Becker, J. (1); Johnston, D. (1)(2); Saunders, W. (1); Wright, K. (1); Leonard, G. (1) and Coomer, M. (1)

(1) Joint Centre for Disaster Research, GNS Science, PO Box 30368, Lower Hutt 5040, New Zealand

(2) Joint Centre for Disaster Research, School of Psychology, Massey University, Tasman Street, Wellington, New Zealand

Contact Email: J.Becker@gns.cri.nz

Over the last two decades significant progress has been made in New Zealand in understanding the cause of disasters, and how hazards and disaster impacts can be addressed. Additionally, the importance of integrating physical earth science with social science has been given high recognition in New Zealand and as a consequence there are strong linkages between the two, both in research and practice. Despite such progress, New Zealand faces an increasingly evolving and complex social environment, and as a consequence there exists opportunity for improvement in areas related to policy, decision-making and communication.

From a policy perspective, while New Zealand has strengthened its system of emergency management over the last ten years, improvements could be made to ensure that hazard and disaster management policies are more widely integrated across other sectors that have a role in such activities (e.g. resource management, lifelines, health, welfare, insurance, and more).

With respect to communication, while interaction between scientific personnel and practitioners has improved, New Zealand still faces issues related to effectively transferring scientific knowledge into policy and planning practice. At a community level, significant progress has been made in understanding how to best communicate and work with communities to build resilience. Research has shown that community participation, problem articulation, empowerment and the building of trust are essential to helping communities understand and address hazard problems. However more work needs to be done in this area to identify additional indicators of resilience, ensure that resilience-building activities are carried out at an operational level, and that activities are evaluated for their effectiveness.



Finally it is necessary to continue to ensure social science is used to address key areas. For example future work should explore the impacts of long-term recovery; the importance of psychosocial issues during disaster recovery; the value of good decision making for warning systems, land use planning and community resilience; and the identification of influences that enable risk reduction to occur.



RISKY BELIEFS IN A VOLCANIC CRISIS: THE IMPORTANCE OF CONTEXT-SPECIFIC INFORMATION

Crosweller, S. (1); Barclay, J. (2), Simmons, P. (2), Lorenzoni, I. (2) and Robertson, R. (3)

(1) University of Bristol, Dept of Earth Sciences, Wills Memorial Building, Queens Road, Bristol, BS8 1RJ

(2) University of East Anglia, School of Environmental Sciences, Norwich, NR4 7TJ

(3) Seismic Research Centre, University of the West Indies, St. Augustine, Trinidad & Tobago, West Indies

Contact Email: sian.crosweller@bristol.ac.uk

Much time and effort is often spent in the communication of information about volcanic hazards in at-risk regions, particularly during periods of quiescence when scientists and risk managers have more time for such duties. However, such outreach efforts are rarely evaluated and so the impacts are unknown.

Two phases of fieldwork were carried out (a qualitative phase in 2005 and quantitative phase in 2007) on two Eastern Caribbean islands with contrasting historical activity: St Vincent and Dominica. It was found that a number of 'risky beliefs' persist within a significant proportion of the surveyed population; a risky belief being one that could potentially lead to problematic behaviour should there be a volcanic crisis. Using ordinal regression, these beliefs were found to be significantly related to the island of residence (and therefore also past experience), education level, gender, and age group.

The results illustrate the need for information campaigns to be context-specific rather than generic since different populations, and even different groups within a population, require different information. Whilst some of the risky beliefs were anticipated by those responsible for volcanic hazard communication in the region, others were not. Without spending time to understand the local viewpoints, outreach efforts may go unheeded. The benefits of using a mixed-methods approach to this end will also be discussed.



INTEGRATIVE EFFORTS FOR DISASTER RISK REDUCTION: EXPERIENCES FROM THE WORKSHOP FOR KNOWLEDGE SHARING AND COLLABORATION IN VOLCANIC RISK MITIGATION AT GALERAS VOLCANO, COLOMBIA

Garcia, C. (1); Bowman, L. (2); Wilmshurst, J. (3); Ruin, I. (4); Escobar, R. (2) and Bajo, J. (5)

(1) Department of Earth Sciences and Territory, University Milano-Bicocca, Italy

(2) Geological and Mining Engineering and Sciences Department, Michigan Tech University, USA

(3) Department of Psychology, University of Sheffield

(4) National Center Of Atmospheric Research, Boulder, Colorado, USA

(5) Department of Geology, University at Buffalo, USA

Contact Email: carolina.garcia@unimib.it

Galeras Volcano is currently in a very active stage and a large eruption (VEI 3 or larger) is considered possible in the near future. A culturally and ethnically heterogeneous population (including indigenous villages) of approximately 400,000 people distributed in urban and rural areas live within the area that could be affected by volcanic hazards.

The Colombian government through the agency in charge of monitoring and forecasting natural phenomena – INGEOMINAS – with the support of the international scientific community has made a large effort to study and understand the volcano's activity, with the main purpose of providing information for risk management. However, due to the adverse implications of some of the measures that have been adopted to manage the risk, there is a growing opposition to the current risk management policies, among many of the affected groups.

The role of scientists in contributing to solve this conflict is crucial. First, regarding the pure research, in particular the use of scientific information for risk management by explaining and discussing risk information with all the stakeholders using a universally understood language, acknowledging the uncertainty and its influence on risk management decisions. Second, by actively participating in mitigation efforts to contribute to solving social conflicts that may arise in volcanic crisis.

In July 2009 the workshop "Knowledge Sharing and Collaboration in Volcanic Risk Mitigation at Galeras Volcano" was held at the University of Nariño in Pasto, Colombia. The workshop was designed to provide new channels of communication and to increase awareness among all of the stakeholders (including community members, scientists, politicians, technicians) involved in the volcanic risk crisis by giving them a chance to express their experiences and concerns and probing their attitudes and understanding of the volcanic hazards, allowing common appreciation of the various issues involved and therefore facilitate the risk mitigation process.



CRITICAL INFRASTRUCTURE RESILIENCE PROGRAMME: IMPROVING THE RESILIENCE OF CRITICAL INFRASTRUCTURE TO NATURAL HAZARDS

Murphy, D.

Civil Contingencies Secretariat, Cabinet Office, 22 Whitehall, London SW1A 2WHE

Contact Email: david.murphy@cabinet-office.x.gsi.gov.uk

1. In his interim report on the summer 2007 floods, Sir Michael Pitt recommended that *'the Government should establish a systematic, coordinated, cross-sector campaign to reduce the disruption caused by natural events to critical infrastructure and essential services'*. In his final report, he set out five more detailed recommendations about that campaign:

- Rec. 50: Begin a systematic programme to reduce the disruption of essential services resulting from natural hazards by publishing a national framework and policy statement setting out the process, timescales and expectations.
- Rec. 51: Work with infrastructure operators to identify the vulnerability and risk of assets to flooding and publish these in Sector Resilience Plans.
- Rec. 52: Work with infrastructure operators to build a level of resilience into critical infrastructure assets that ensures continuity during a worst case flood event.
- Rec. 53: Place a specific duty on economic regulators to build resilience in the critical infrastructure.
- Rec. 54: Extend the duty to undertake business continuity planning to infrastructure operating Category 2 responders.

2. To take forward these recommendations, the Government announced actions and a timetable for maintaining power and water supplies and protecting essential services:

By 30 June 2009

- (a) Establish Natural Hazards Team (NHT) to counter the risks to national infrastructure from natural hazards;
- (b) Publish National Framework for action and Policy Statement.

By 31 December 2009

- (a) Sector Resilience Plans in place to provide flood resilience to the most critical national infrastructure sites.

3. The Pitt Review also called for guidance for economic regulators to be published by mid-2009 (recommendation 53).

Natural Hazards Team

4. The Natural Hazards Team was established in May 2009 within the Cabinet Office Civil Contingencies Secretariat. The team is charged with co-ordinating efforts to identify and counter the risks to national infrastructure from natural hazards. The team will coordinate the work of the systematic programme, working with Lead Government Departments, Economic Regulators and industry.



National Framework and Policy Statement

5. The National Framework and Policy Statement is being developed and it will propose a standard of resilience from flooding for critical infrastructure. The Natural Hazards Team is working with Government departments, regulators and the industry to investigate whether standards should differ for the most critical sites and across sectors. The merits, proportionality and impacts of resilience standards will be tested on economic, social and environmental grounds.

6. Guidance for regulators will be developed on how they can support a national long-term programme of cross-sector resilience building (recommendation 53), and how resilience measures will be funded.

7. The final policy for improving resilience and standards for all natural hazards will be set out in the National Resilience Plan to be published in 2010.

Sector Resilience Plans

8. The Natural Hazards Team is undertaking an initial vulnerability assessment of critical national infrastructure from flooding. This will inform the scope of Sector Resilience Plans, which need to set out plans to improve the resilience for the most critical sites in each sector by December 2009 (recommendations 51 and 52).

Long-term Programme

9. In the longer term, the Natural Hazards Team will ensure there is a sustained programme for resilience building of critical infrastructure, which includes business continuity planning on an all-hazards basis (recommendation 54).



WHY 'SMALL IS BEAUTIFUL' IN MUNICIPAL DISASTER PREVENTION

Wilkinson, E.

Department of Geography, University College London, Pearson Building, Gower St., London, WC1E 6BT

Contact Email: emily.wilkinson@ucl.ac.uk

Understanding differences between local governments and their capacity to deal with disasters is fundamental to the promotion of disaster risk reduction. A decentralised, partnership approach to disaster prevention is advocated by international organisations and in policy documents, including the Hyogo Framework for Action, but the capacity of local governments to formulate and implement disaster risk reduction strategies with the participation of communities and other stakeholders is not well understood. This paper examines disaster prevention practices in five municipalities exposed to hurricanes in the southeast of Mexico and identifies key factors contributing to their performance in disaster mitigation, preparedness, response and recovery activities. The small, costal municipalities with less financial and human resources, are found to have greater capacity to reduce the risks associated with hurricanes, suggesting that geographical and institutional proximity may be more important to DRR than the level of funding.



PATHWAYS TO ACCOUNTABILITY FOR DISASTER RISK REDUCTION

Polack, E.

Centre for Climate Change and Development, Institute of Development Studies, Brighton,
BN1 9RE

Contact Email: e.polack@ids.ac.uk

Accountability as a fundamental principle for equitable, effective, efficient and transparent delivery of services can be as easily applied to Disaster Risk Reduction as any other policy arena. As a principle for exposing and addressing power relations between a collection of actors and activities overtime it is relevant to DRR particularly when it provides mechanisms and conditions within with to tackle the underlying vulnerabilities of socio-economically, politically or geographically marginalised communities. Accountability allows us to examine how citizens are able to receive or demand information, services and support relevant to reducing risks to disasters. There are currently few progress or process indicators for the Hyogo Framework for Action for citizens to measure state performance on DRR, and even less recognition for which rights apply to resolving underlying vulnerabilities.

Advancing pathways to accountability for DRR requires widespread understanding of a state's legal and moral obligations to deliver on all components of disaster resilience. Citizens are required to be familiar with relevant rights, policies and mechanisms. This research explores the relevance of accountability for the delivery and achievement of DRR. It then asks how emerging DRR policy and implementation frameworks can strengthen accountability as a social process, particularly in relation to challenging risk enhancing activities of the state or conditions of vulnerability resulting from poverty and a lack of basic needs and rights.

The cases of three civil society organisations in three locations in the Philippines are examined through research with them, the citizens they work with and the local government in their locations. These cases expose the diversity of issues that can be considered as DRR and how accountability of state actors at local and national levels for each should be seen as critical for addressing underlying vulnerabilities. This paper also argues that national advocacy work on DRR policy must be responsive to local accountability gaps if national policy change and mainstreaming endeavours are to be effective and reach those on the frontline of disaster impacts.



POSTER PRESENTATIONS

USE OF COMPREHENSIVE SOCIAL SURVEYS AS KEY ELEMENTS OF EFFECTIVE AND INTEGRATED COMMUNITY BASED EARLY WARNING SYSTEMS

Garcia, C.

Department of Earth Sciences and Territory, University Milano-Bicocca, Italy

Contact Email: carolina.garcia@unimib.it

According to the Hyogo Framework, Community Based Early Warning Systems are essential elements to accomplish disaster risk reduction and should include the proactive participation of all the actors or stakeholders involved, including scientists, politicians, technicians and in particular the members of the communities living in the areas that could be affected by the hazard. Furthermore, EWS must be multidisciplinary and integrated, including all the stages of the early warning process: hazard assessment with evaluation and forecasting; monitoring and preparedness; emission and dissemination of the warning message and finally but most important of all, a good public response capability of the people exposed.

In order to be effective, EWS must be adapted to the local conditions of the area of interest, considering not only the characteristics of the hazard phenomenon but also the actual risk perception, needs and hazard knowledge of the local stakeholders (including local community, technicians and decision makers).

This presentation will introduce an Community Based EWS which is being developed in the Mountain Community of Valtellina di Tirano, north of Italy. An area continuously affected by flooding and mass movements. As a first stage of the EWS, comprehensive questionnaires have been applied. The preliminary results show that despite the fact that most of the people surveyed had experienced hazardous events in the past, the risk perception is very low as well as the self efficacy and preparedness levels. Notwithstanding, responses to survey questions indicate that the community has high levels of interest in receiving information about natural hazards, and is willing to participate proactively in education campaigns, which constitutes another phase of the EWS that addresses the preparation of people for a future event and at the same time, increases the level of interaction among the people of the community, scientists and local authorities.



ARTICLE 25: BUILT SOLUTIONS TO SOCIAL PROBLEMS

Reilly, E.

Article 25, London

Contact Email: emily-reilly@article-25.org

Article 25 is a UK based NGO working across Africa, Asia and Eastern Europe to provide built solutions to social problems. Our namesake is the 25th Article of the Universal Declaration of Human Rights which supports the belief that adequate, dignified buildings and housing are fundamental to our human rights. It also enshrines other basic rights which require a built contribution to their fulfilment. Article 25 aims to cement and elevate the critical role that the built environment plays in the fulfilment of human rights and millennium development goals.

Understanding the role of the built environment in the provision of social services, which are essential to the development of human capital, brings the quality of these buildings to the forefront. For article 25 and the users of our buildings, quality refers to: a safe, structurally sound, strategically located, culturally relevant structure that involves the end users in a participatory design process; utilises vernacular architectural techniques and building materials; builds the capacity of local workers; is climate responsive; and, importantly, cost effective from construction through to maintenance.

Article 25 partners with NGOs with tight budget restrictions, and UK practitioners, to design and construct social infrastructure. Our projects thus far include: seismic resistant housing (Pakistan); schools (Sierra Leone and India); children's homes in (Lesotho, Ghana and Mozambique); conservation facilities (Sierra Leone); primary health awareness centres (Ethiopia and Lesotho); and cultural heritage sites (Afghanistan and Romania). Our services include bespoke design and construction management, masterplanning, post construction evaluation, community consultation; participatory design; and professional development courses (CPD) for practitioners and students. We are soon to launch an online Knowledge Community on Development and Disaster relief hosted on the RIBA website. For more information please visit our website www.article-25.org or email emily-reilly@article-25.org



EXPLORING THE USE AND VALUE OF VISUALS USED IN THE SOUTHERN CALIFORNIA SHAKEOUT 2008 PUBLIC EARTHQUAKE PREPAREDNESS CAMPAIGN

Bottomley, H. K.

Department of Earth Sciences, University College London, Gower Street, London, WC1E 6BT

Contact Email: helenkbottomley@ucla.edu

This study explores the use and value of visuals utilised as part of the Southern California ShakeOut 2008; a public earthquake preparedness campaign which culminated in a region-wide earthquake drill. Visuals were used as part of the ShakeOut's public outreach, to convey the magnitude 7.8 large-scale San Andreas Fault earthquake that was the scenario basis for ShakeOut. The three primary visual types utilised in the ShakeOut were maps, animations and videos. This study focuses on the Preparedness Now short film, USGS ShakeMap and animation of ground-shaking.

Investigation of the role of visuals is centred in the fields of marketing, and more recently principles have been utilised as part of public health and safety campaigns. In these fields the role of visuals in influencing viewers' emotions and capability for persuading targeted response is widely recognised. However current understanding of the role of visuals in public disaster preparedness campaigns is limited.

This study offers practical insights into the value and role of the visuals used as part of the ShakeOut campaign. Through conducting interviews with members of the ShakeOut committee, emergency management and community response staff, and gauging the views of members of the general public – it is evidenced that the ShakeOut visuals were successful in conveying the intended informational messages of the ShakeOut.

However the findings of this study also highlight the essential need for user pre-testing and evaluation of visuals and other educational resources, in order that they may be further developed to suit the needs of end-users.

The study also highlights the potential for visuals to play a much larger role in outreach and audience engagement, as part of the ShakeOut and other public disaster preparedness campaigns.



DRILLS AS PART OF AN EXPERIENTIAL LEARNING CYCLE FOR DISASTER RISK REDUCTION EDUCATION - NOT JUST ANOTHER BUREAUCRATIC EXERCISE

Sharpe, J.E.

Department of Geography, King's College London

Contact Email: jesharpe@mac.com

Disaster prevention education that is effective takes note of the wider environment. Schools need to develop their own emergency plans to deal with a range of situations that occur so that students and teachers know how to react appropriately.

A very practical and realistic way of engaging teachers and training them about the need to prepare themselves and their students is through regularly practiced drills. Drills and other experiential activities are designed to shape knowledge and behaviour. Efforts to make these effective will be strengthened by our understanding of how people respond to risk communications and how the process of adoption of “hazard adjustments” for individual/family risk reduction and preparedness activities can be encouraged.

There is a body pedagogical research that strongly indicates that experiential learning, in which the experience of the learner at the heart of the strategy, hold untapped promise for disaster risk reduction education (DRRE). Drills, of course, are inherently intended to be an experiential learning activity. Complementary activities that engage participants in learning by doing, experiencing and then, after reflection, acting hold similar promise for DRRE.

This paper will further develop gap analysis carried out while observing two earthquake drills in schools in Los Angeles, California and Taiwan. Their strengths and weaknesses will be examined alongside ways in which drills can be embedded into experiential learning cycles that make drills more meaningful and less abstract for both teachers and students. Arguments will be made for the need to apply multiple intelligence theory for education, teaching and learning in order to develop and use effective educational resources that engage the widest audience. Drills can and should be the stimulus for learning and knowing what to do in a hazard event, whereas good educational resources and curricular (including complementary experiential activities) can help the learner make sense of the drill experience.



DEVELOPING CRITERIA FOR POST IMPACT RELIEF, RECOVERY AND MITIGATION

Buckle, P.

Monash International Initiative for Community Resilience and Aon Benfield UCL Hazard Research Centre

Contact Email: philip.buckle@gmail.com

Three years ago the British Overseas Non-Government Organisations for Development (BOND) began a programme to develop criteria for assessing progress towards post disaster recovery for affected individuals, families and communities. These criteria would also be used to guide policy development and implementation.

The problem this programme responded to was that there is no agreed guidance on recovery priorities, no template for developing and managing recovery programmes, no standards for governments, agencies and communities to work to and no means of determining when recovery has been satisfactorily achieved.

This programme involved research with local communities in the UK, Australia, Laos, Sri Lanka, Indonesia and the Dominican Republic and consultation with a wide range of government agencies and national and international non-government agencies.

After exhaustive debate a set of principles and criteria have been developed as a guidance and framework for policy makers and as a template for local communities to measure their progress towards recovery.

These principles and criteria have another practical purpose in ensuring that governments and recovery agencies are accountable for the priorities they set, the resources they allocate and the schedules they apply to meeting critical needs in health, housing, food and water, sanitation and other services and in ensuring that these are provided in an equitable, timely and efficient manner.

This paper will describe the initial problem, the process towards drawing up the principles and criteria, how they may be applied and work towards further development and implementation



CAN A SUSTAINABLE LIVELIHOODS APPROACH BE USED TO ASSESS THE EFFECTIVENESS OF A COMMUNITY-BASED EARLY WARNING SYSTEM?

Karakashian, C.

Department of Earth Sciences, University College London, Gower Street, London, WC1E 6BT

Contact Email: colettekarakashian@hotmail.com

Disaster early warning systems have been progressively attracting more attention since the early 1990's (UN, 1995; Parker, 1999), and are largely recognized as one of the most practical and effective ways in which to save lives, minimize property damage, and secure livelihoods and sustainable development (Maskrey, 1997). No definitive template or design of what constitutes an early warning system exists and therefore each system by virtue of climatic, socio-economic and political context is unique and specific to the community in which it operates (Glantz, 2004). What does however define the ultimate success of all early warning systems is the degree to which it is effective in improving the resilience of a community in the face of a disaster (Parker, 1999). However, there are very few well-documented case studies that outline in detail the reasons why a particular early warning system is effective and most studies have a propensity to undertake evaluation after rather than before a disaster when there would be sufficient time to make appropriate adjustments to the system that would further minimize future losses (Parker, 1999). Without the documentation of good and bad practice it becomes increasingly difficult to progress the field of research and thus there exists a gap in academic and practitioner's literature for case studies that better document how and why different early warning systems are effective and the evaluative methods and tools used to determine this. This study documents and evaluates a community-based early warning system used for flood and typhoon warnings in Santa Eulalia, a small rural community in the Bicol Region in the Philippines and uses a modified sustainable livelihoods approach as a means of evaluation.



TERRA VIVA - A NETWORK OF SEISMOMETERS IN SCHOOLS OF FOGO ISLAND, CAPE VERDE

Narciso, J.; Ferreira, H.; Faria, B.; Custodio, S.; Omar, Y. (1); Heleno, S.; Fonseca, J. and Day, S. (2)

(1) Technical University of Lisbon

(2) Aon Benfield UCL Hazard Research Centre, Department of Earth Sciences, University College London, Gower Street, London WC1E 6BT.

Contact Email: yasser.omar@ist.utl.pt and simonday_ucl@yahoo.co.uk

Terra Viva [Earth Alive] is a joint project of the NGO SiW - Scientists in the World (<http://www.siw.org/en/>) and the EU FP7 research project MIA-VITA, *Mitigate and Assess risk from Volcanic Impact on Terrain and human Activities*, namely its node at IST-Technical University of Lisbon. This project consists of installing seismometers and establishing a network between three schools in Fogo Island, Cape Verde, and on developing an educational program with the following goals:

- To promote awareness for the volcanic risk at Fogo Island
- To promote the experimental and multidisciplinary teaching of science, particularly geophysics
- To promote the active participation of the students on the learning process, specifically through project-based learning and their individual and collective creativity
- To promote the integration between the school activities and the scientific and technical community, as well as with the general population

The first seismometer was installed in June 2009 in the S. Filipe highschool. Mosteiros and Cova Figueira are expected to follow in the fall. Throughout the school year of 2009/10, a series of activities with the teachers and students are planned, from the use of the seismometer signals in the classroom to the survey of the local population about their perception of the volcanic risk.



THE STANDARDISATION OF VOLCANIC ALERT LEVEL SYSTEMS (VALS)

Fearnley, C. (1); McGuire, W. (1); Twigg, J. (2) and Davies, G. (3)

(1) Department of Earth Sciences and Aon Benfield UCL Hazard Research Centre, University College London, Gower Street, London, WC1E 6BT

(2) Aon Benfield UCL Hazard Research Centre, University College London, Gower Street, London, WC1E 6BT

(3) Department of Geography, University College London, Gower Street, London, WC1E 6BT

Contact Email: c.fearnley@ucl.ac.uk

Volcano Alert Level Systems (VALS) have been adopted in many volcanically-active countries as a form of communications tool between scientists and other stakeholders, designed to ensure the safety of the at-risk population and minimization of economic impact, through definition of the level of potential danger from volcano hazards. A number of volcano crises have highlighted weaknesses within the VALS prior to and during the announcement of an alert level, yet there is minimal understanding of the operation of the processes involved in issuing alerts. VALS, in their current form, must therefore be regarded as 'black boxes'. Better understanding of this 'black box' should aid the development of robust VALS in different geographical, institutional and cultural contexts.

There are places in which these institutional contexts are now changing. In recent years a number of VALS have become standardised for different volcano hazards or styles of volcanic activity. Using insights into the process of standardisation from the sociology of scientific knowledge, this paper argues that the motivations for, and experiences of, standardisation, may be used as a way to open up and understand the processes influencing the operation of a VALS and to reflect on its implications. Prior to standardisation, VALS may have been locally based, focusing on an individual volcano or area and incorporating some aspects of the local society and culture, thereby serving the needs and understanding of the vulnerable population. Standardisation involves complex drivers that have the potential to reveal the cultural, institutional and scientific priorities influencing the construction of the VALS.

This research uses interview techniques and historical documents to explore the driving forces behind standardisation of VALS within the United States Geological Survey (USGS). Standardisation may have different outcomes for different groups, offering gains for some and a potential loss of flexibility for others. This research thus also explores the experiences of standardisation for the USGS observatories and the impact on their ability to provide an effective warning to different user groups.



Aon Benfield UCL Hazard Research Centre
Department of Earth Sciences
University College London
Gower Street
London, WC1E 6BT

T: +44 (0)20 7679 2429 / 2452

F: +44 (0)20 7679 2390

W: www.ucl.ac.uk/drrconference